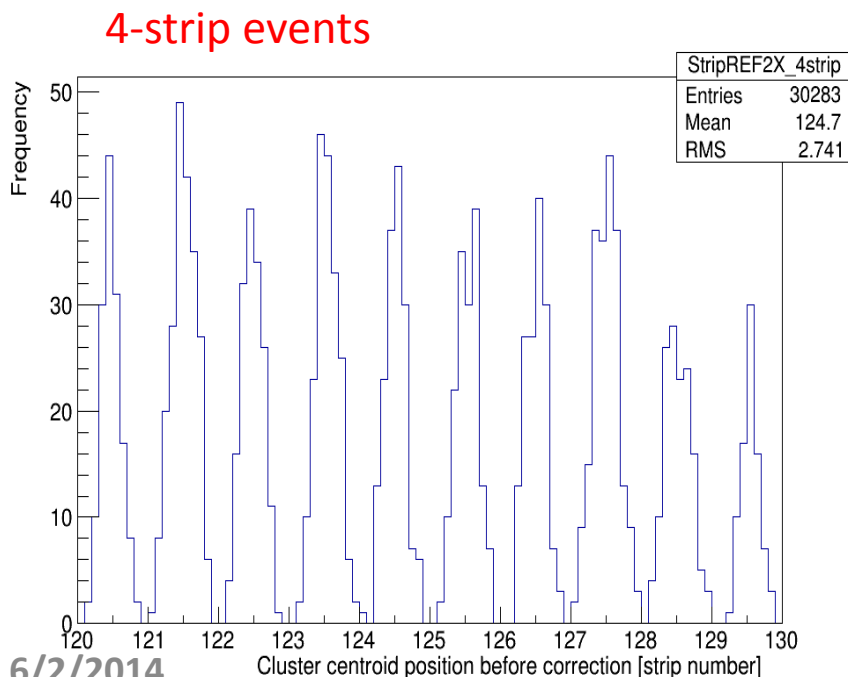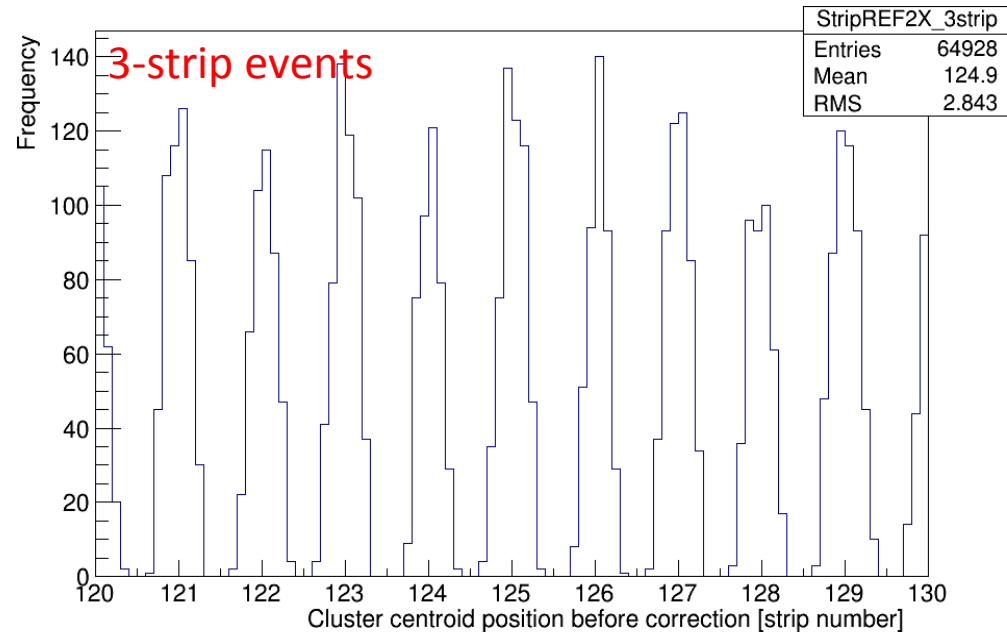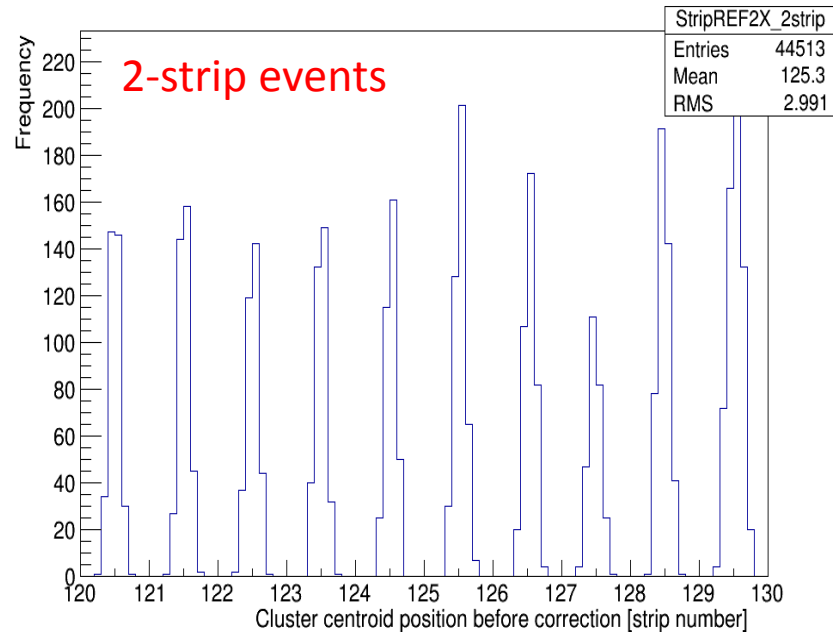# FNAL beam test update --
First results of strip response correction

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02/06/2014

Position distributions before correction

2-strip events

StripREF2X_2strip	
Entries	44513
Mean	125.3
RMS	2.991

3-strip events

StripREF2X_3strip	
Entries	64928
Mean	124.9
RMS	2.843

4-strip events

StripREF2X_4strip	
Entries	30283
Mean	124.7
RMS	2.741

- **Cluster centroid position is calculated using Center of Gravity (COG) method, in terms of strip number.**
- **Strip position is defined in its middle**
- **Position distributions show evident strip dependence: 2-strip events mainly in the middle of two strips; 3-strip events in strip-center; even 4-strip events in between two strips.**
- **The plots are from the first tracker in X axis.**
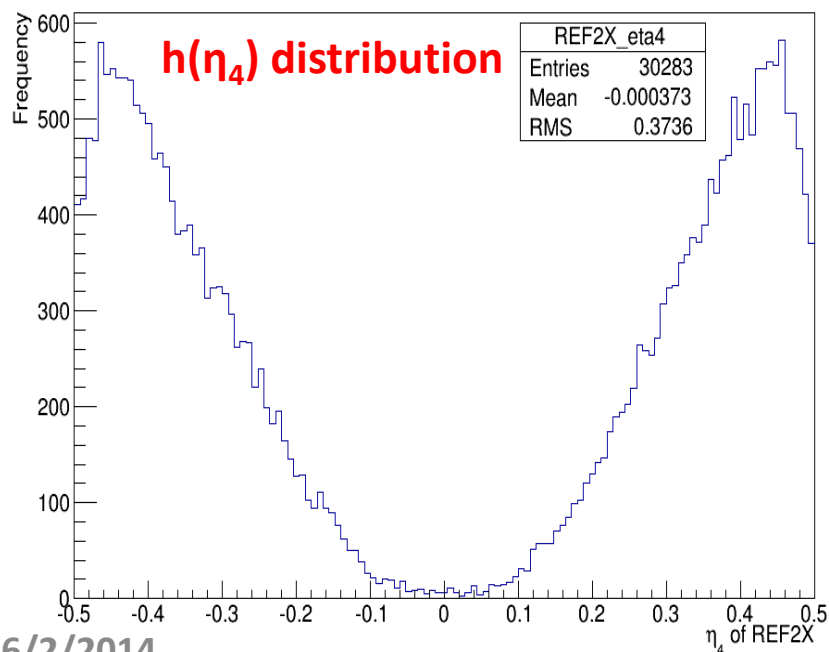
6/2/2014

Position correction method

- Define $\eta_N = \frac{\sum_i (s_i - s_m) q_i}{\sum_i q_i} = s_{centroid} - s_{max}$, for <u>cluster size >1</u> strip events.

s_{max} is the strip which has maximum charge; $s_{centroid} = \sum s_i q_i / \sum q_i$ is the center of gravity position in terms of strip (cluster centroid position); N is cluster size.

- Mainly reference: ([PhD thesis CERN-THESIS-2013-284 by Marco Villa](#)).
- $|\eta_N|<$(N-1)/4 for odd N; $|\eta_N|<$(N-2)/4 for even N; $|\eta_2|<$1/2. For N=2,3,4, η_N in the range of [-0.5,0.5], for N=5, η_N in [-1,1].
- The histogram for each selected N is regarded as a function h(η).

- The new cluster centroid position in <u>strip</u> is calculated event by event:

$$s'_{centroid} = s_{max} - 0.5 + \frac{\int_{-0.5}^{\eta'} h(\eta) d\eta}{\int_{-0.5}^{0.5} h(\eta) d\eta}$$

> Use boundary
> -1 and 1 for N=5

- The new cluster centroid position for <u>tracker</u> is calculated by:

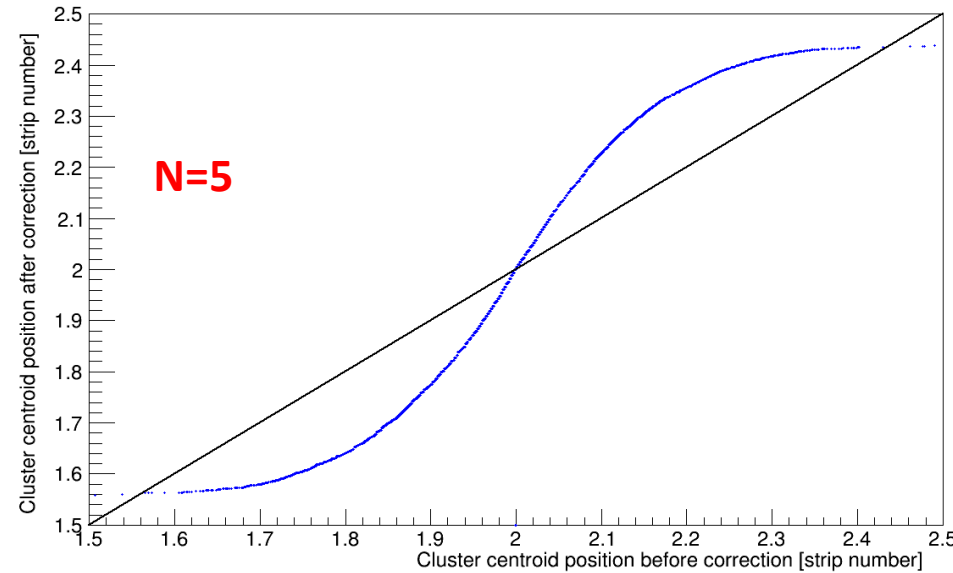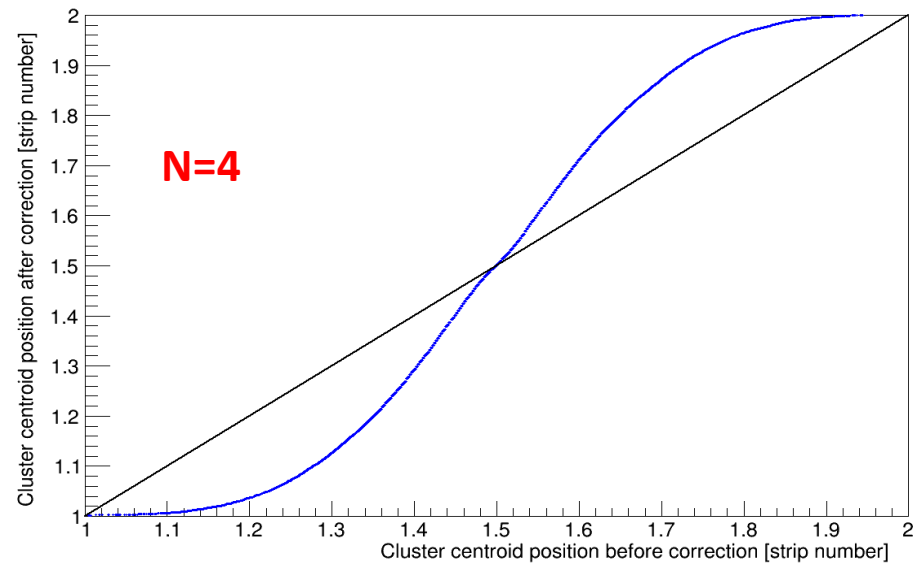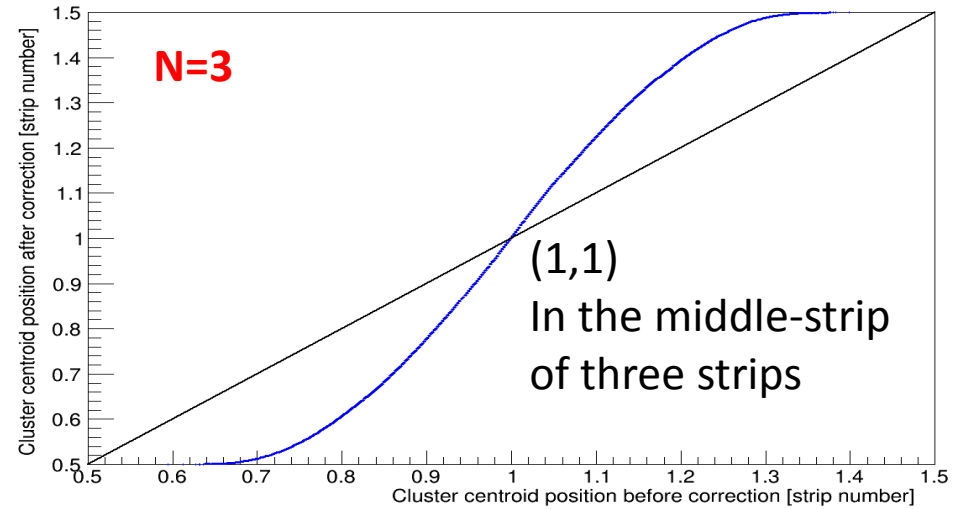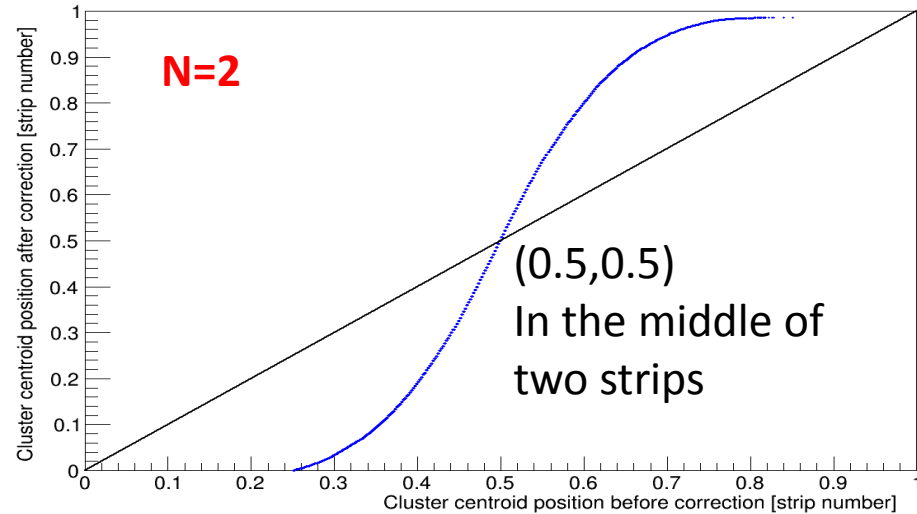$$x'_{centroid} = -0.5 * planeSize + stripPitch * s'_{centroid}$$

For radial zigzag / CMS GEM:

$$\varphi'_{centroid} = -0.5 * openningAngle + anglePitch * s'_{centroid}$$
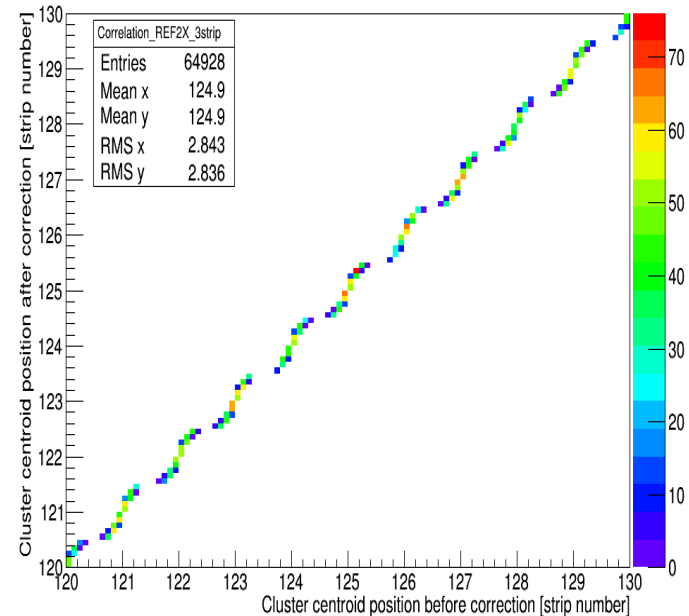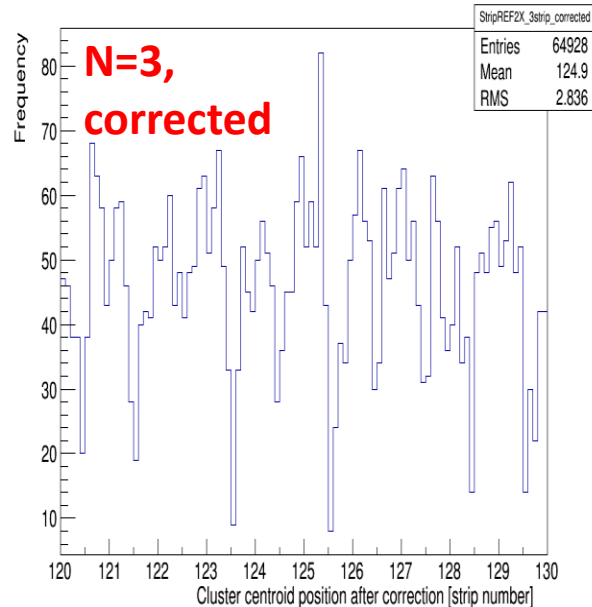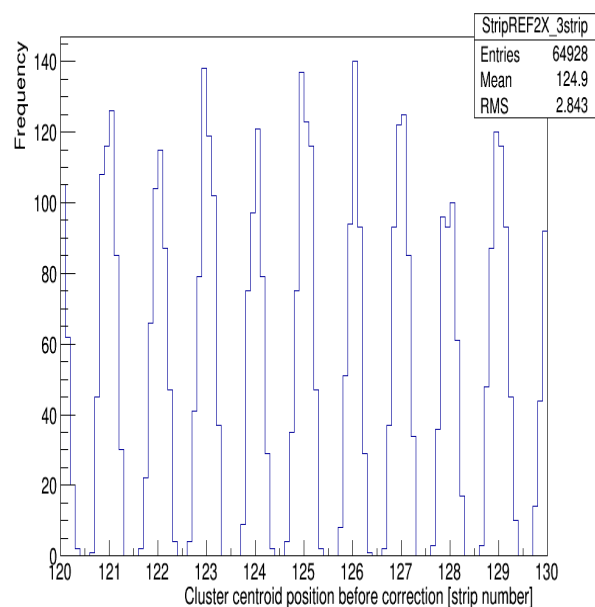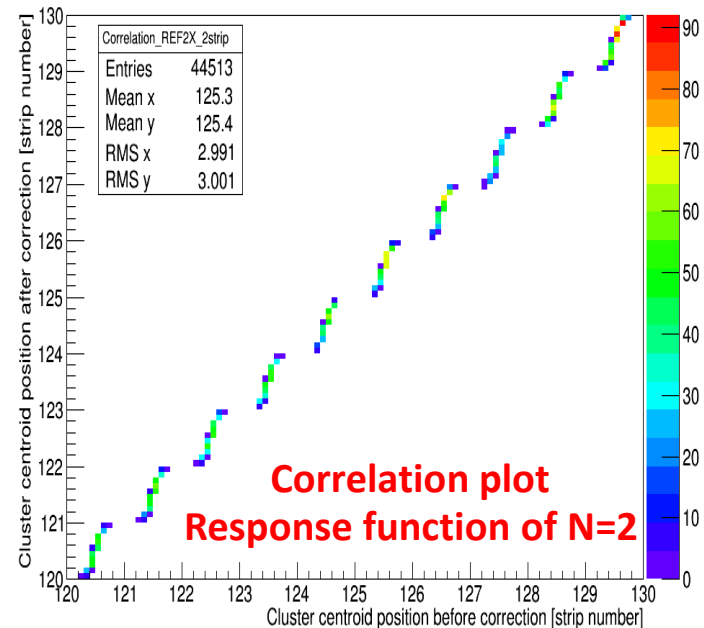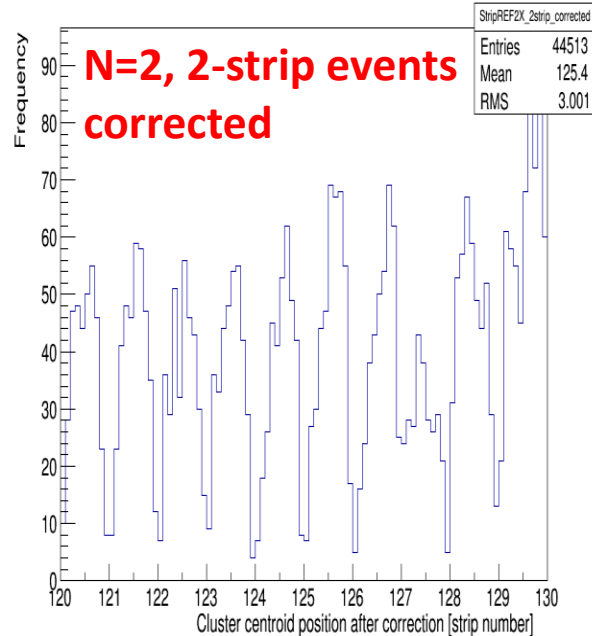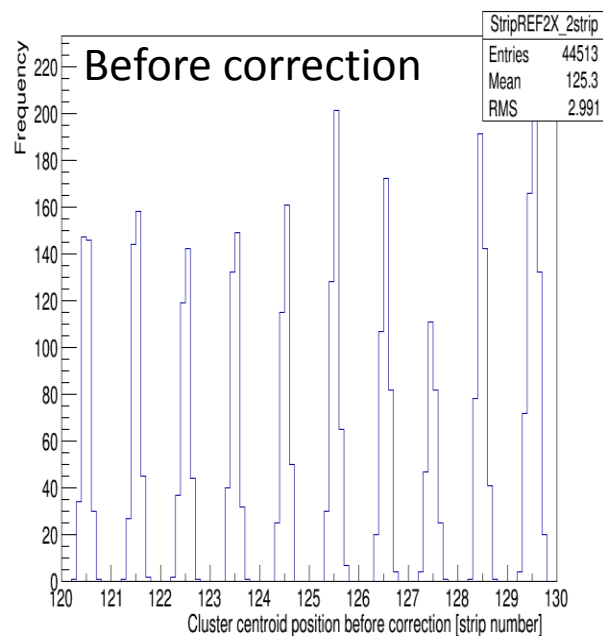
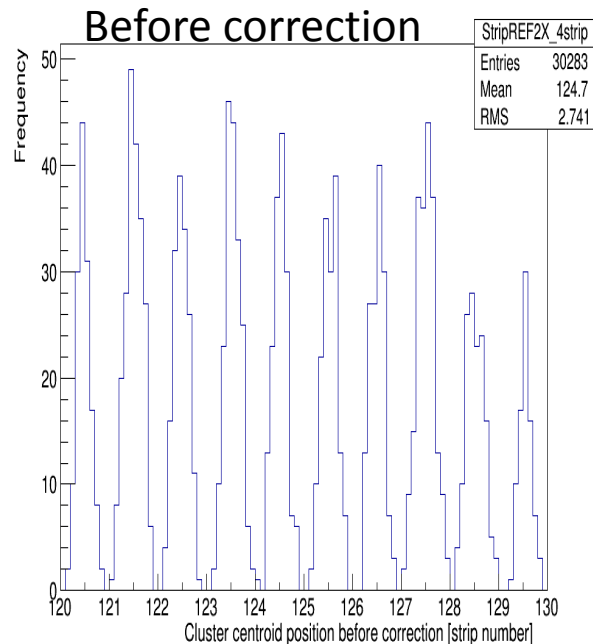# h(η_N) distributions, N=2,3,4,5
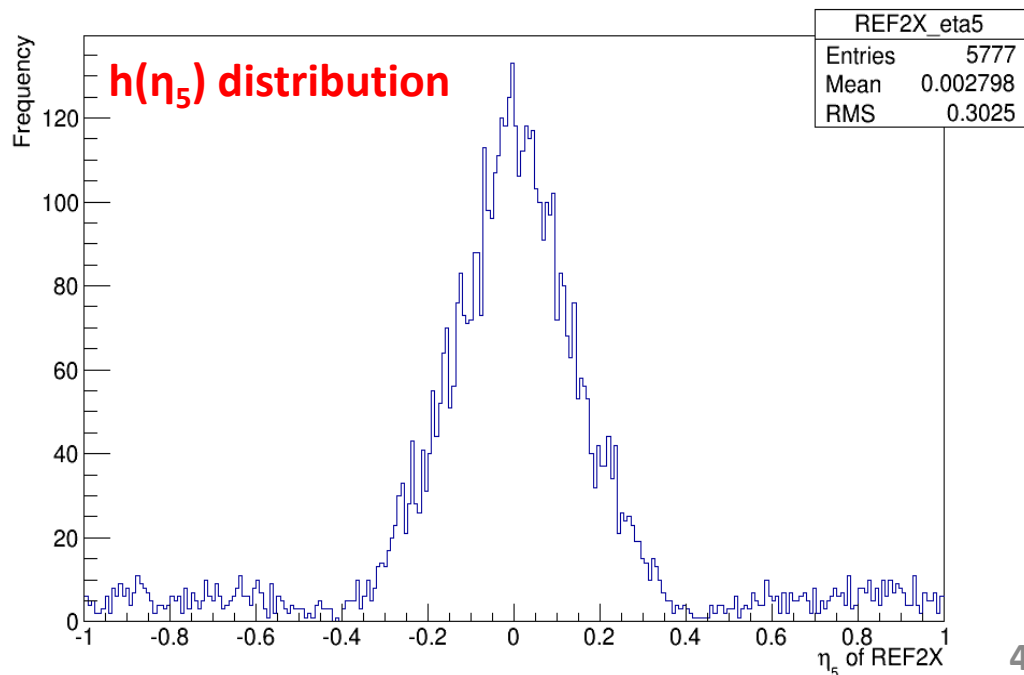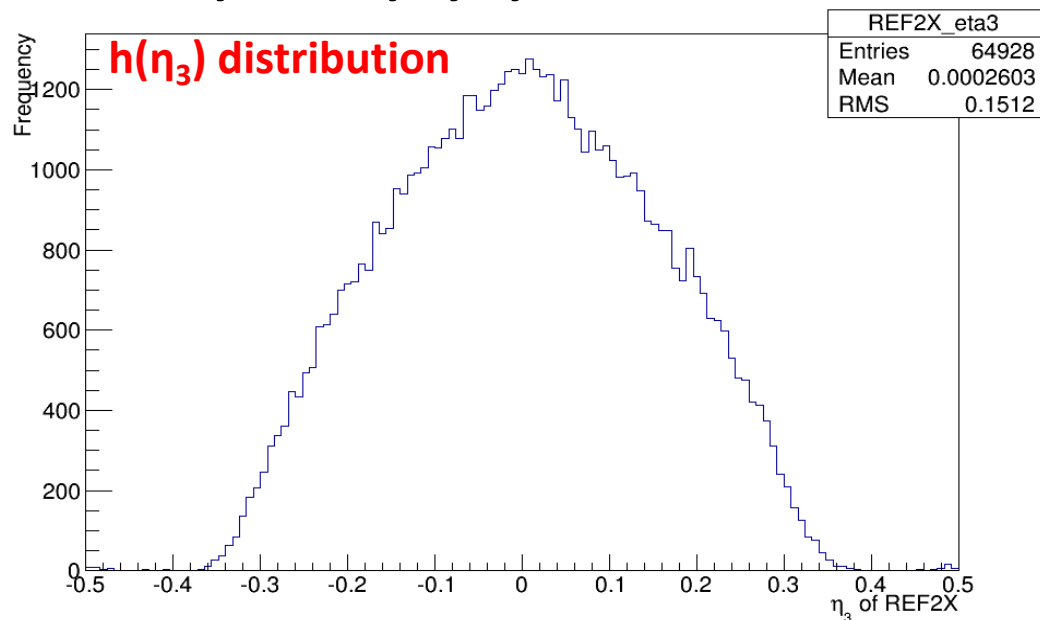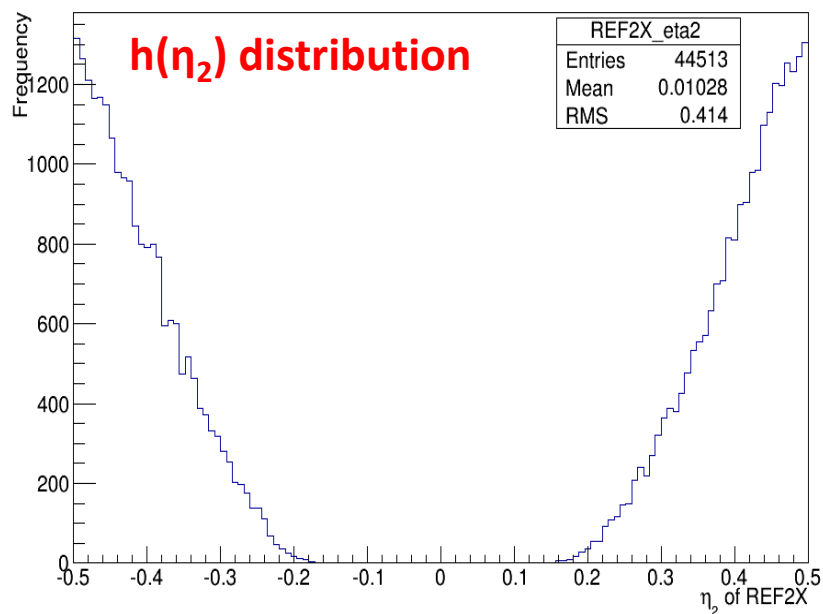
Response functions for N=2,3,4,5

- Use 0, 1, 2, … to label strip number (drop off the real strip number)
- Position after correction vs. before correction scatter plot describes the response function for each N. Response function is a kind of sigmoid function.
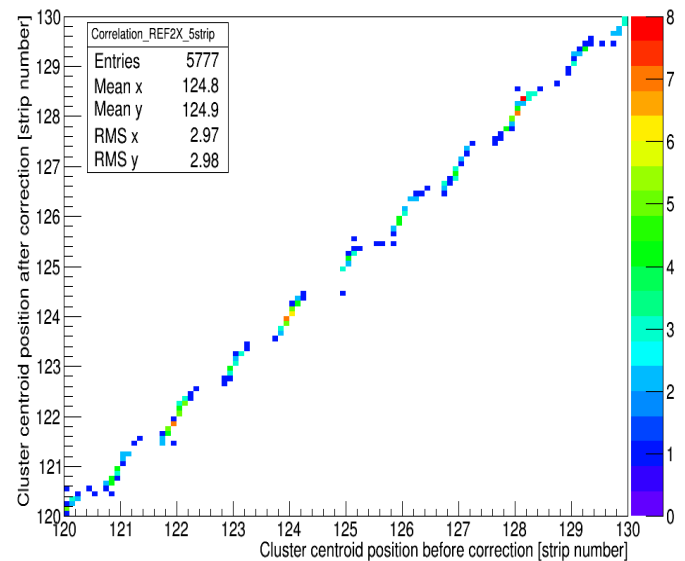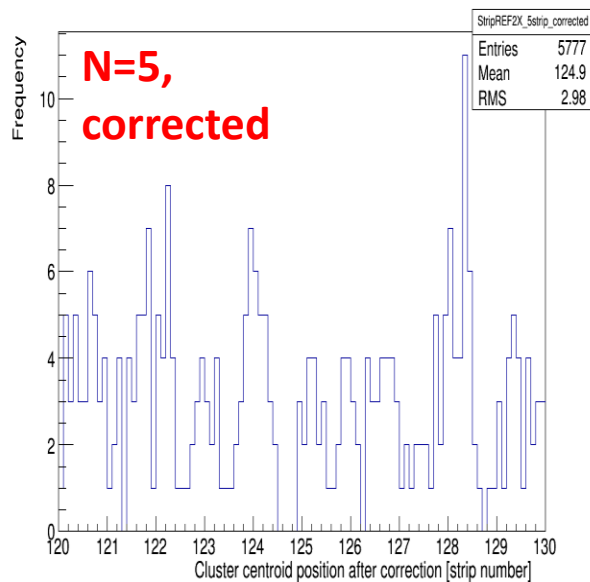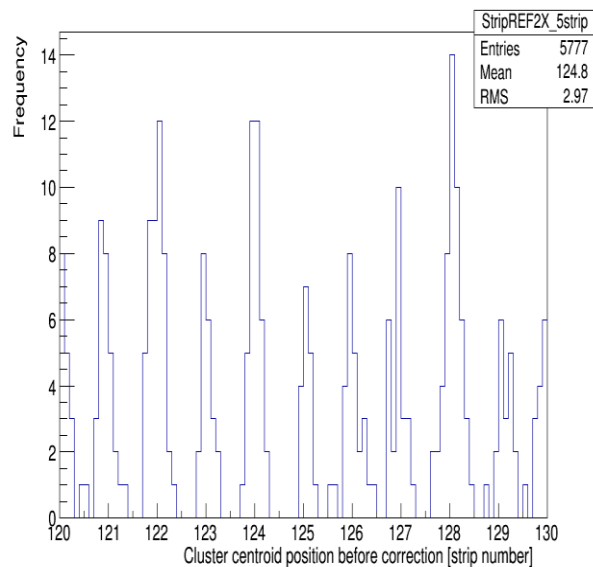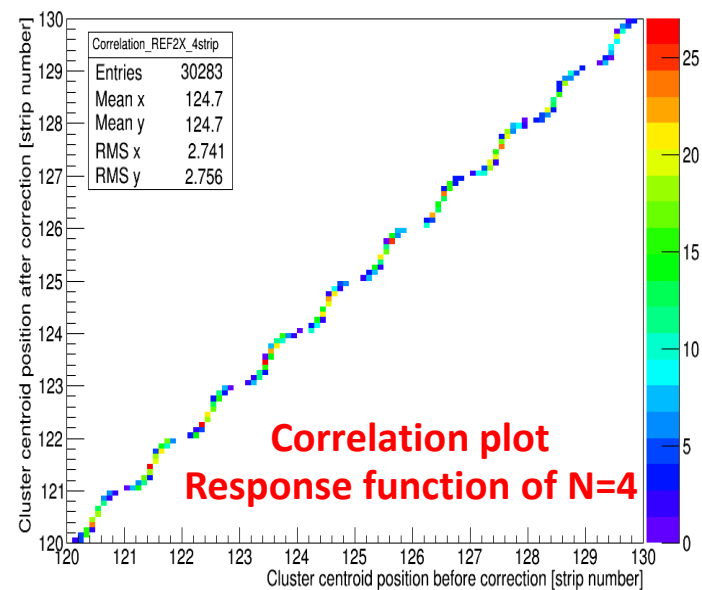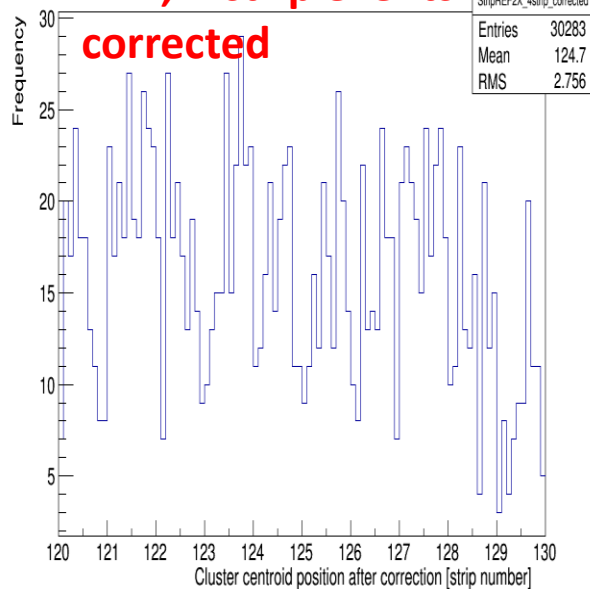
Position distributions after correction

Position distributions after correction

Before correction

N=4, 4-strip events corrected

Correlation plot
Response function of N=4
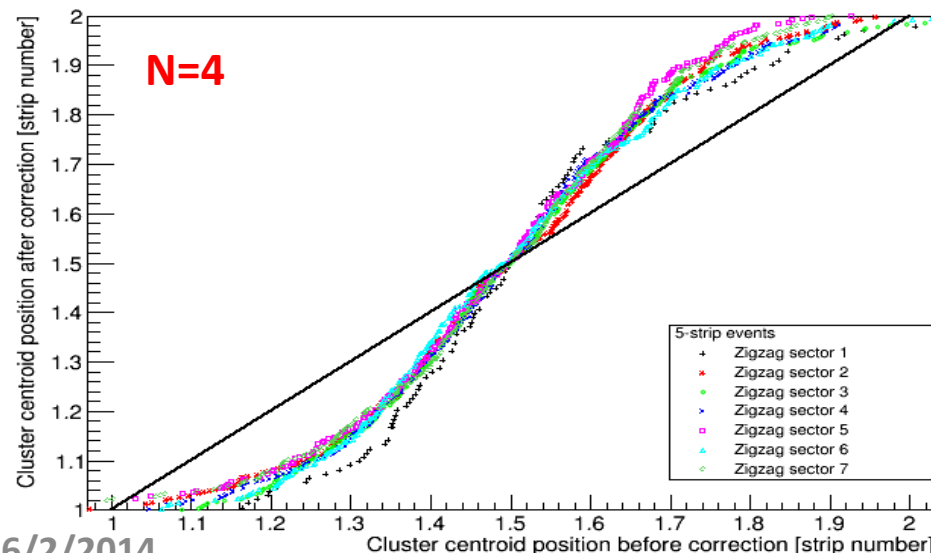
N=5, corrected
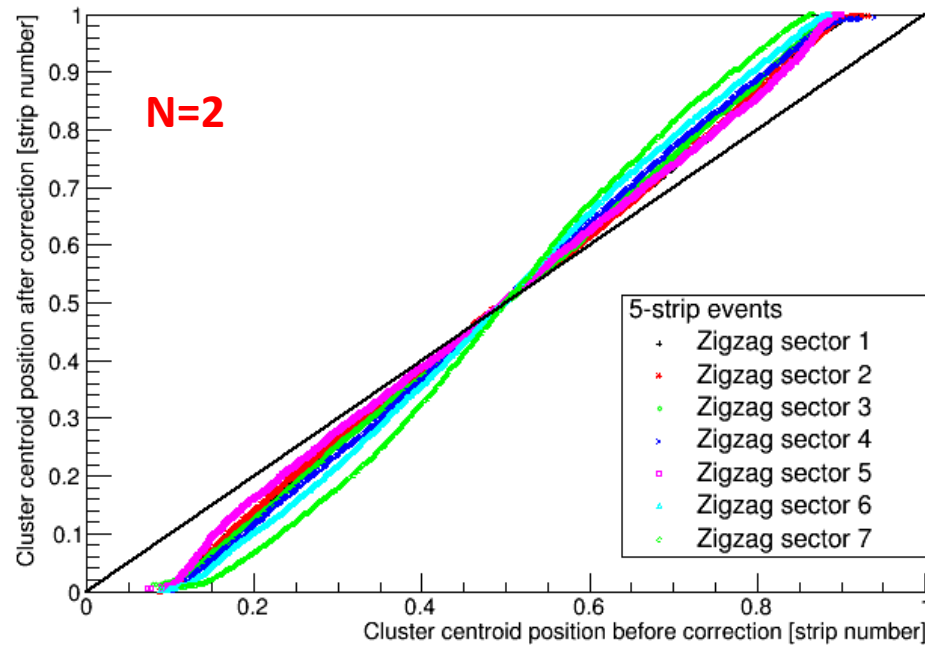
Correction for the Zigzag GEM
# – response functions at different sectors
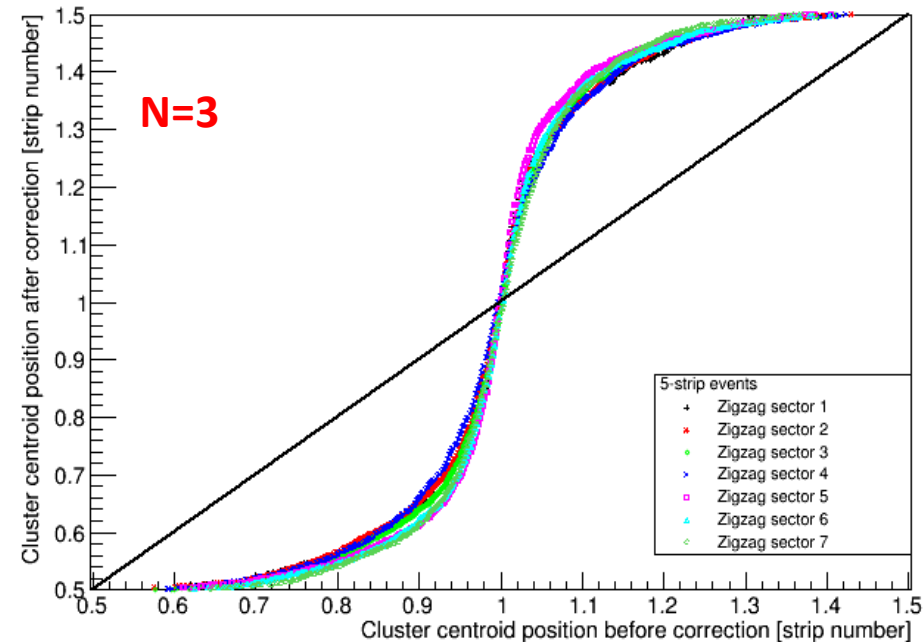
- Zigzag behaves similar as the trackers, N=2 case is more flat than trackers. (because of zigzag charge sharing?)
- Responses on different sectors are very close, don't see sector-dependence.
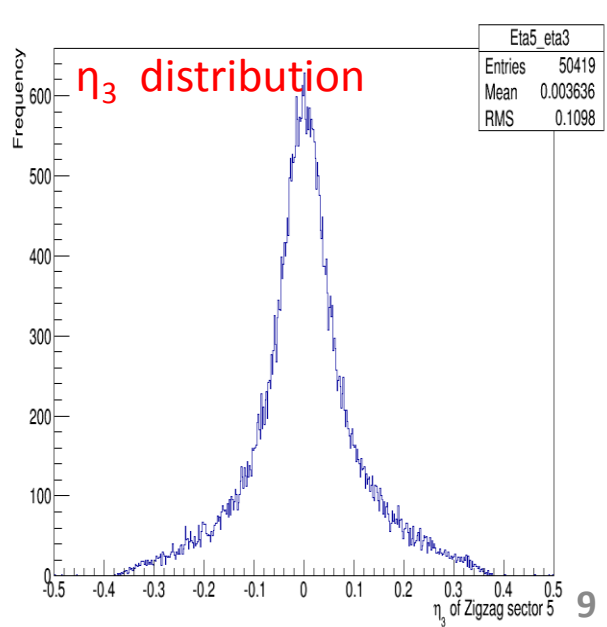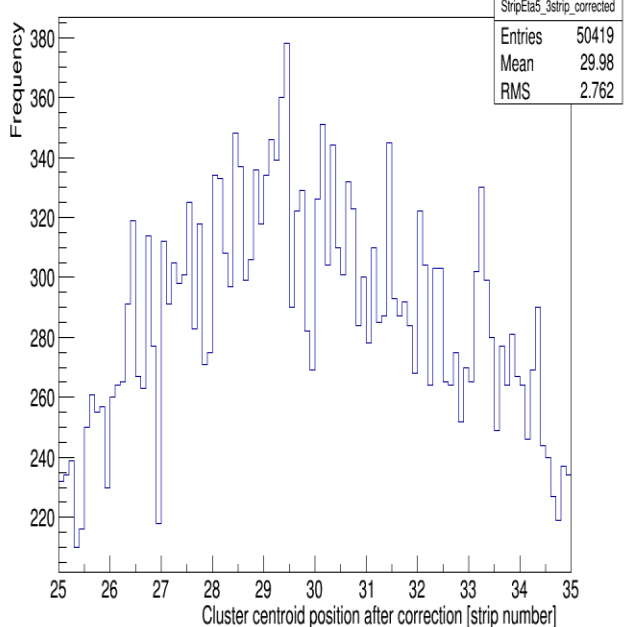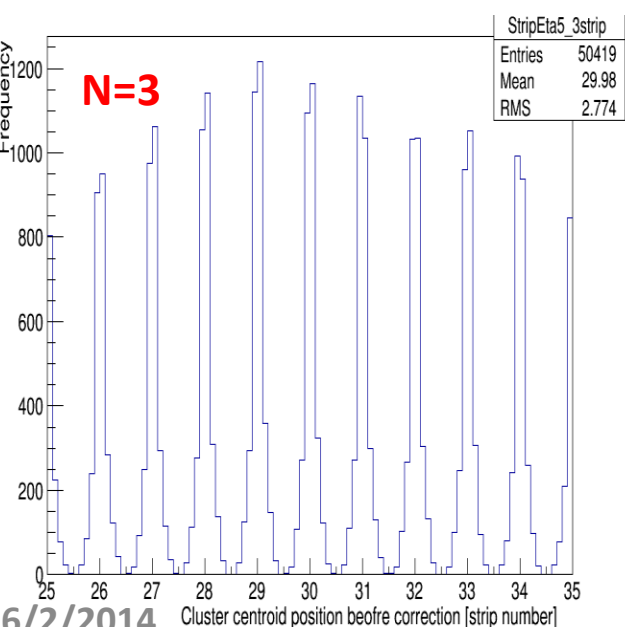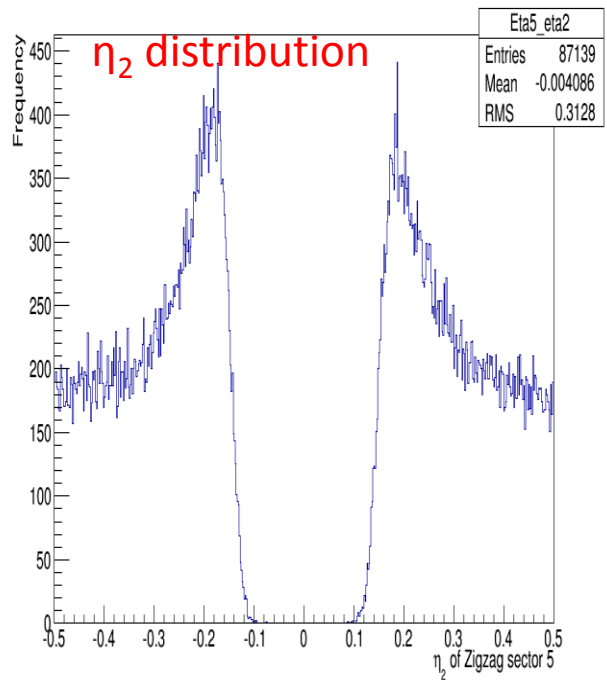
Corrections results for **zigzag on sector 5** (HV scan data were combined to have more statistics.)

N=2

η_2 distribution
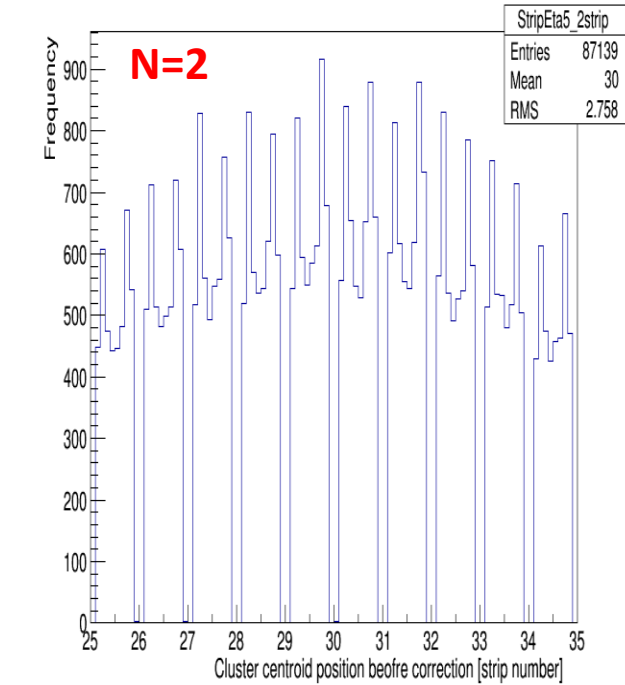
Before correction

After correction

N=3
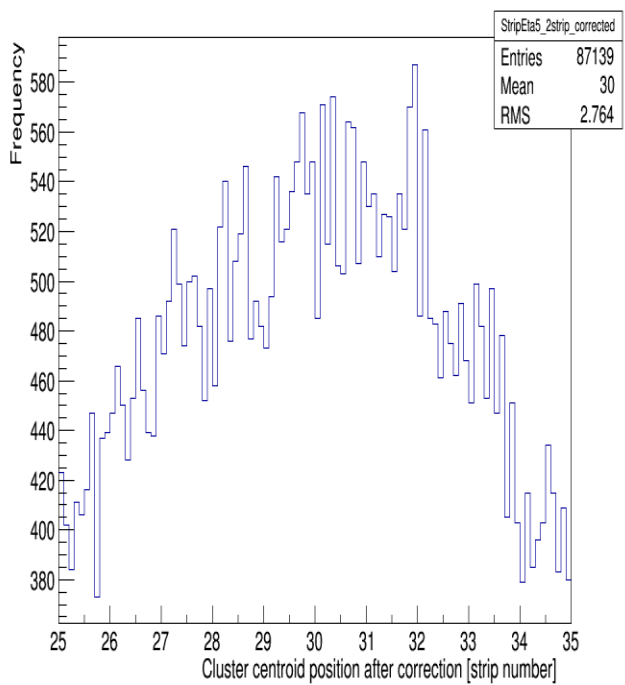
η_3 distribution

Summary

- Position correction method seems working properly, <u>2, 3, and 4-strip events</u> can be corrected with more confident.

- After correction, trackers need to be aligned again. Zigzag GEM / CMS GEM also need a realignment.

- Resolutions for trackers (with only 2,3,4-strip events) don't change significantly (within ±6μm).

- Next is to get resolutions for zigzag GEM and CMS GEM.

Thanks.